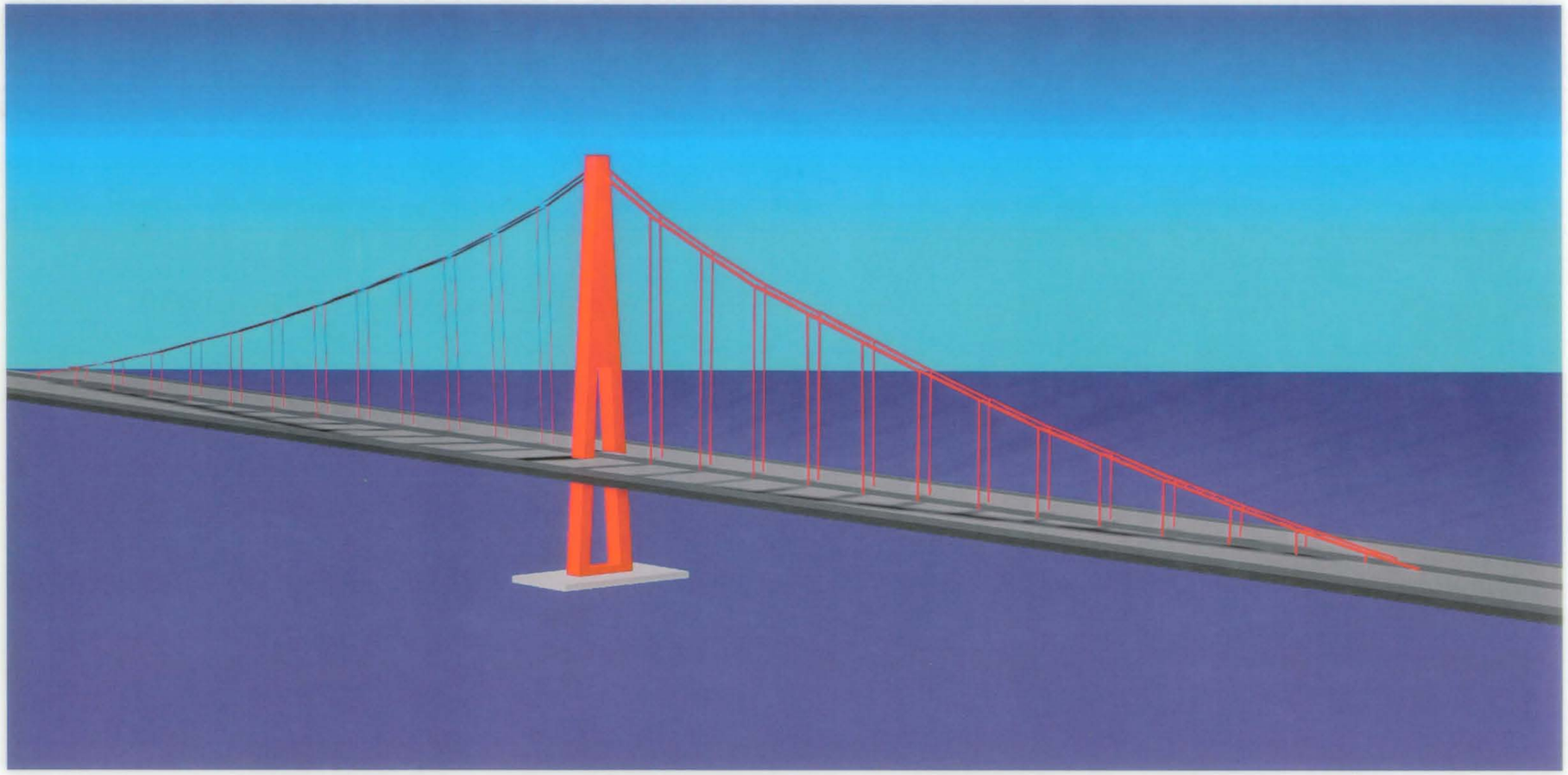
METROPOLITAN
TRANSPORTATION
COMMISSION

NEW EASTERN SPAN OF THE BAY BRIDGE



INITIAL SUBMITTAL • MAY 6, 1997

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NEW EASTERN SPAN OF THE BAY BRIDGE

SUSPENSION BRIDGE AND TWIN VIADUCT PROPOSAL

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Initial Submittal, May 6, 1997

1. Introduction

The present report is in response to the Metropolitan Transportation Commission's Bay Bridge Design Task Force request to receive presentations from interested parties on proposed designs for the new eastern span. It is understood that an Engineering and Design Advisory Panel (EDAP) has been convened to assist the Task Force in recommending a preferred design.

This report is submitted as the Initial Submittal, due on May 6, 1997 and as a condition to be invited to present a proposed design at the EDAP Workshop, May 12-14, 1997.

The current proposal has been developed by the Gerwick/Sverdrup/DMJM Joint Venture, currently working for Caltrans on the seismic upgrading design for the Richmond-Ran Rafael Bridge. Assistance has been provided by COWI, Ben C. Gerwick, Inc.'s parent organization, and Dissing & Weitling (Architects).

2. General Description

Traffic entering the East Bay Bridge northern alignment alternative from Oakland will be supported on a gently curving one-level skyway bridge. Drivers will have an excellent view of the bridge landmark, the mono-tower self-anchored suspension bridge at Yerba Buena Island. After passing the suspension bridge drivers will again, via a gentle transition, enter into the existing tunnel and further onto the West Bay Bridge.

The concept of a mono-tower suspension bridge complements and blends in full harmony with the other suspension bridges in the Bay Area and provides a landmark entry to the City of Oakland.

In elevation we propose a classic suspension bridge and in section we propose a modern designed structure with an A-frame tower and centrally placed cable-planes. The self-anchored suspension bridge takes advantage of the bridge deck as a compression element. Viscous dampers at the expansion joints will provide additional seismic redundancy in the longitudinal direction and will connect the adjacent bridge decks.

The suspension bridge deck is proposed as one integrated box girder with a steel trough and a lightweight concrete roadway deck. Achieving low weight will have a direct impact at minimizing the amount of cable-steel. The closed box girder concept allows for a centrally suspended girder capable of transferring torsion between the supports. The tower-girder connection is envisaged as a redundant "monolithic" connection.

The tower will be the focal point of the crossing - both visually and structurally. The tower can be founded directly on rock and constructed in either steel or in concrete.

The skyway bridge is outlined with two identical cross sections consisting of pre-cast lightweight concrete - one for each traffic direction. Spans in the 400'-550' range will be optimized for the deep soft soil conditions that require relatively expensive foundation construction. The same span lengths will be considered throughout the bridge to optimize lifting and transport equipment and the layout of prefabrication facilities which will minimize the construction period and cost.

The bridge deck is supported on two pre-cast concrete columns interconnected with beams to provide ductile seismic frame action in the longitudinal direction. This arrangement allows the bents to be "tuned" to optimize their response to strong ground shaking during an earthquake.

The piers are founded on large diameter steel pipe piles driven through pre-fabricated concrete pile cap caissons that are floated into position and used as templates during pile driving operations.

The interchange structure on Yerba Buena Island is proposed as a cast-in-place concrete structure. It is recognized that traffic interruption while changing traffic flows from the existing bridge to the new bridge must be minimized. The new spans at the transition can be cast-in-place on skid beams - placed outside the bridge alignment, and extended under the existing bridge. After removal of the existing bridge, the new bridge can be skidded into place.

Alternatively, it could be feasible to construct the new deck adjacent to the existing bridge and progressively slide it over into position as portions of the existing deck are removed on a lane by lane basis. This would require the new bents to be constructed first under the existing deck, much like the west trestle replacement of the Richmond-San Rafael Bridge.

The additional considerations that may impact the design the bridge:

- Height restrictions by the Federal Aviation Administration should be obtained. The proposed suspension bridge pylon is equal in height to the West Bay Bridge pylons.
- Addition of pedestrian and bicycle facilities is included in our proposal.
- Accommodation for future rail allowance has been made for dual track rail on sky way bridge section. However, present configuration of suspension bridge pylon only allows for single-track rail.

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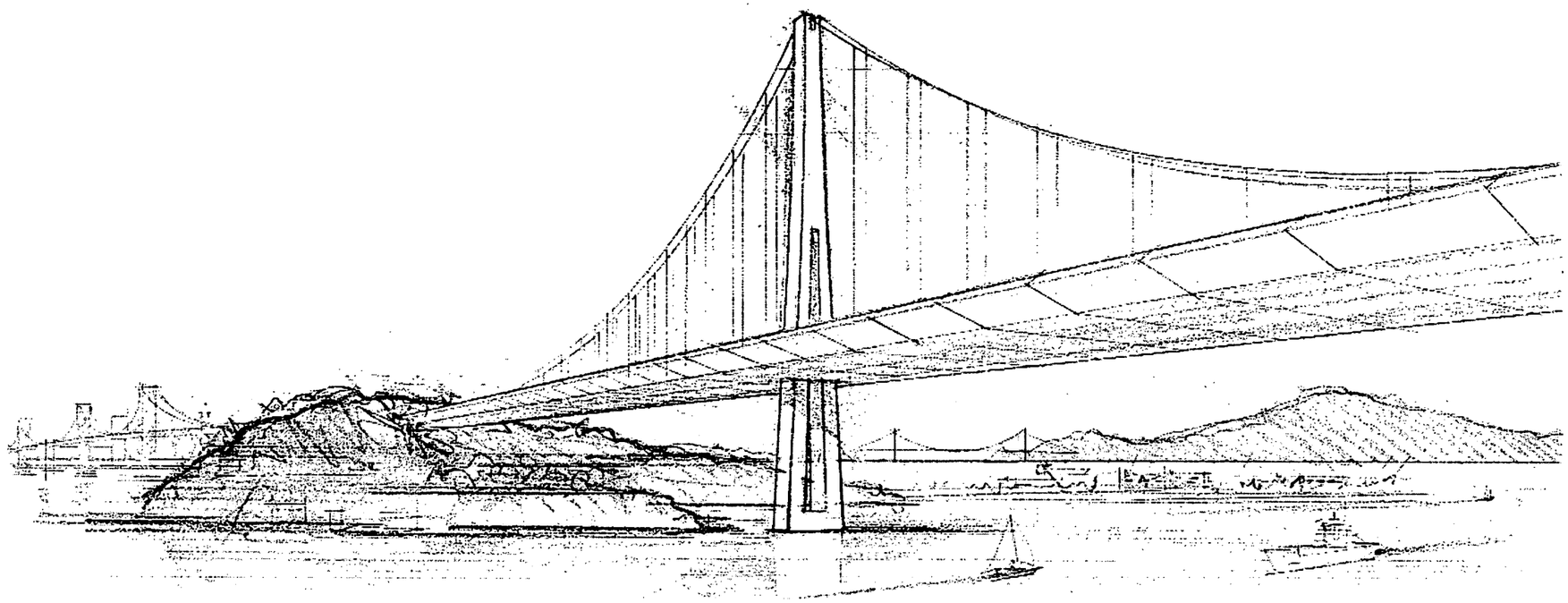


3. Structural Considerations

Post-earthquake performance of the proposed structures is high. The proposed concepts can be designed to provide emergency as well as normal traffic service (lifeline service) after an earthquake on either the Hayward or the San Andreas Fault systems.

Some damage during a large seismic event is expected - e.g. controlled plastic hinging at the connection between pylon and pier-footings and foundation caissons and between frame segments of pylons and piers. Thermal deck joint may require replacement. No damage is allowed in the foundations below high water level.

All cast-in-place closure joints between the large pre-cast concrete caissons, pier shafts and deck sections will be provided with continuous (coupled) mild steel reinforcement and pre-stressing.

Drop-type vulnerabilities will be eliminated and modern seismic devices incorporated at expansion joints.

4. Design Considerations

The aesthetics of the new bridge has been developed with due regard to being an experience in harmony with the other landmark suspension bridges of the Bay Area. The chosen design does not clutter the Bay with more divergent bridge types.

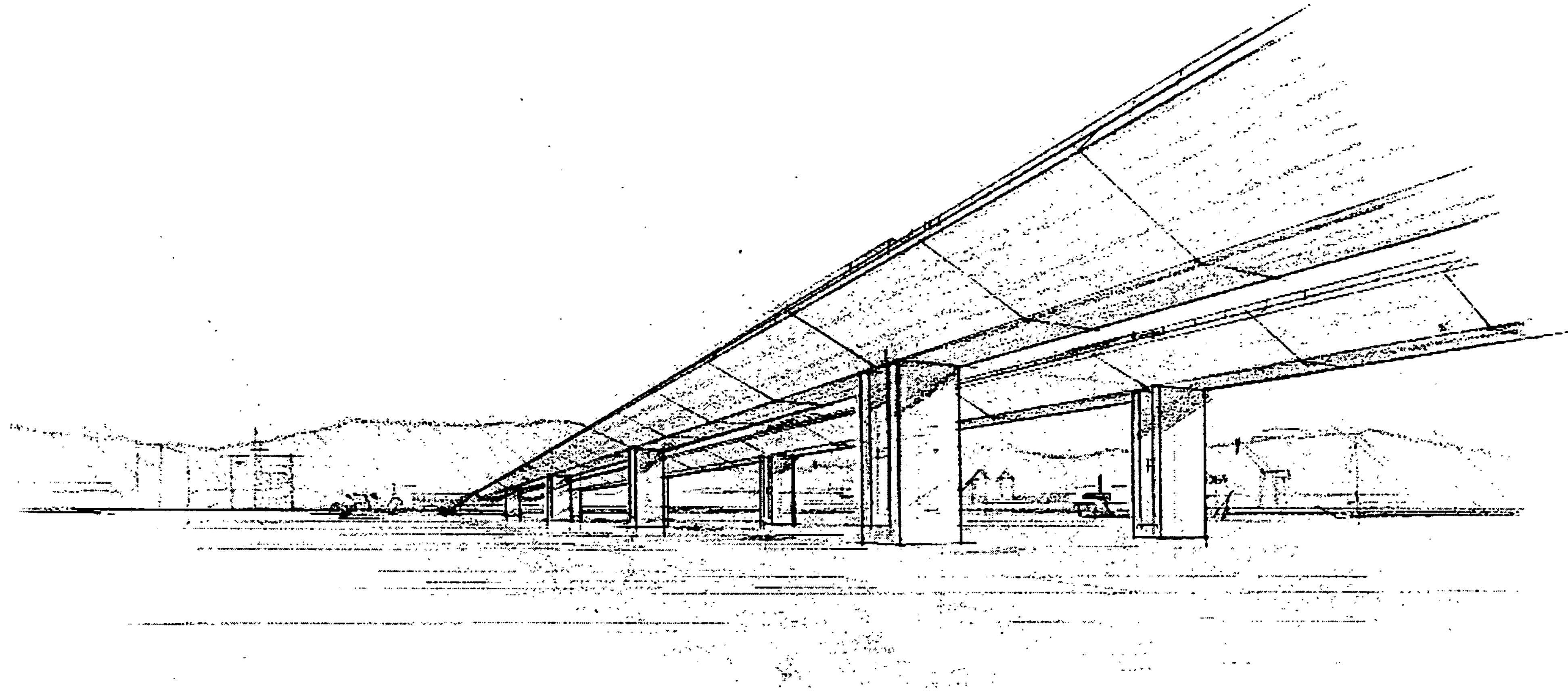
The Replacement Bridge complements the West Bay Bridge suspension span and combines the bridge elements while at the same time providing a gateway to Oakland.

5. Environmental

The design of the new span has been performed with sensitivity to environmental concerns and awareness of physical and cultural elements that may be at risk as a result of inappropriate design and construction actions.

Adverse impacts on wetlands in the Emeryville Crescent will be minimized by restricting the footprint of the affected area - generally favoring an alignment with a short path through wetlands and using elevated spans rather than embankments, and by using design features which allow for free circulation below the structure from side to side of the roadway.

Both in the wetlands and in open water areas, any necessary bay fill and dredging will be associated with pier construction. These elements will be minimized by minimizing the number of piers (using longest practicable span lengths between piers) and by pier



design which avoids massive islands.

The proposed design with extensive use of on-shore prefabrication will minimize impact on the Bay and Yerba Buena Island.

The northern alignment alternative of the new span has been designed to minimize impacts on sensitive wetland areas in the Emeryville Crescent and minimizes bay fill and dredging. The longer bridge length required by this alternative may be economical and desirable since it would allow the point of land supporting the existing bridge approach to be restored for increased Bay shore access. An alignment following the existing freeway between the Toll Plaza and the current abutments is subject to very vulnerable liquefiable soils - potentially requiring a pile supported deck structure.

The southern alignment has the benefit of shorter overall length and bypasses the historic properties at Yerba Buena Island.

The potentially most sensitive wildlife features at risk include birds, fish and harbor seals. Peregrine falcons and double-crested cormorants are known to nest on substructures of the Bay Bridge. Design of the new east span will include substructure features that allow for continuation of such nesting, as well as for the cormorants' practice of "roosting and loafing" on bridge substructures.

6. Highway Design Standards

The required geometry on the bridge roadway as that required by Attachment 2 has been complied with.

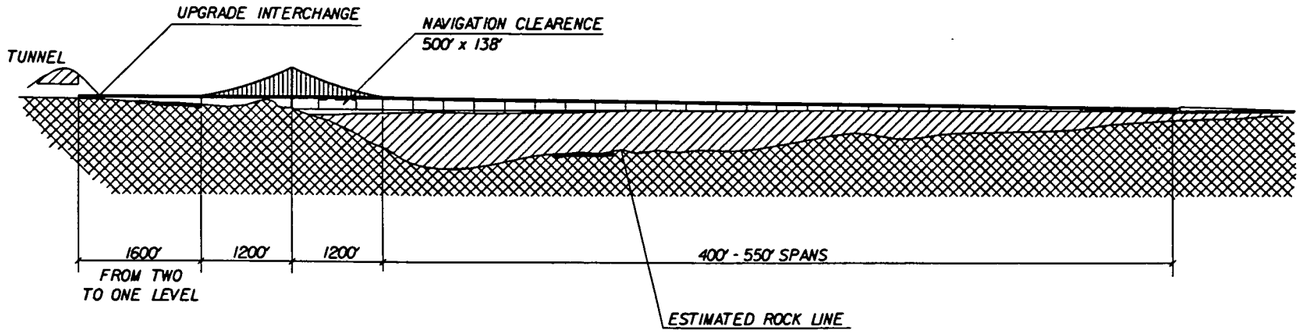
7. Pedestrian-bikeway Design Standards

Potential provision of two-way pedestrian-bikeway has been allowed for.

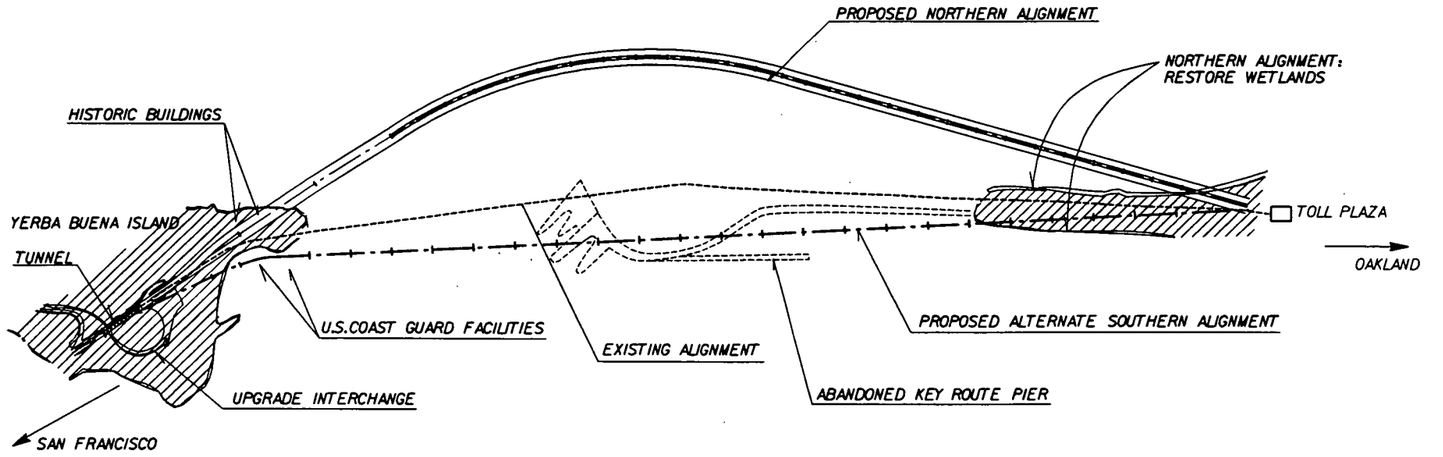
8. Maintainability

The design of both the suspension bridge and the skyway bridge is based on full on-shore pre-fabrication in a controlled environment to facilitate quality assurance and a high quality product of both steel and concrete components. Cast-in-place operations in the field are limited to well prepared sections and details that can be readily inspected during construction.

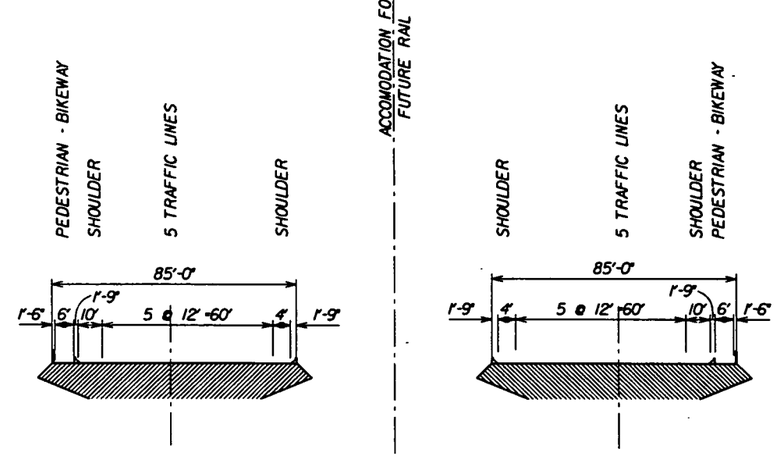
The interior of the box girder for the suspension spans will be corrosion protected by dehumidifying of the interior.



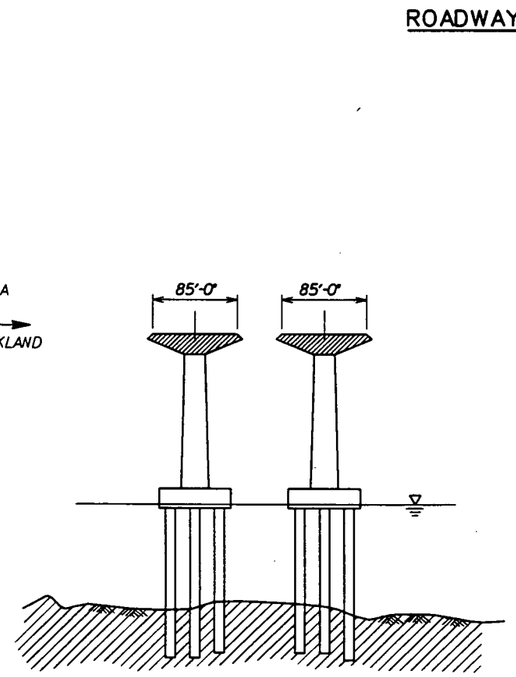
VERTICAL ALIGNMENT



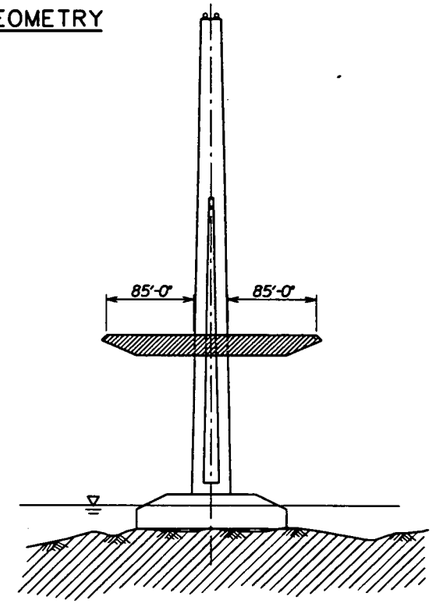
HORIZONTAL ALIGNMENT



ROADWAY GEOMETRY



VIADUCT BRIDGE



MAIN BRIDGE

EAST BAY BRIDGE REPLACEMENT

SUSPENSION BRIDGE AND TWIN VIADUCT PROPOSAL

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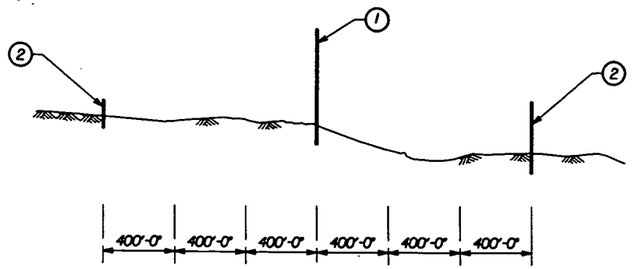
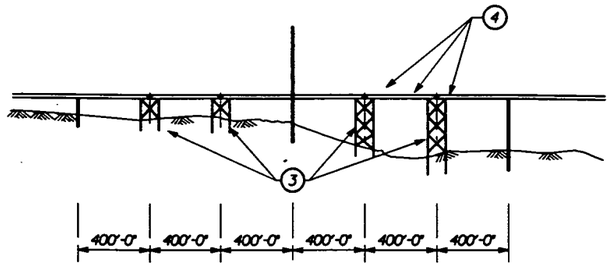
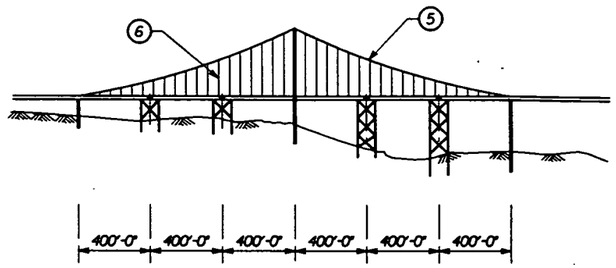


(1) ERECT PYLON
(2) ERECT SUSPENSION BRIDGE END BENTS

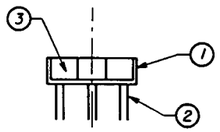


(3) ERECT TEMPORARY STEEL BENTS
(4) PLACE SUPERSTRUCTURE DECK IN 400' SEGMENTS USING HEAVY LIFTING CRANES

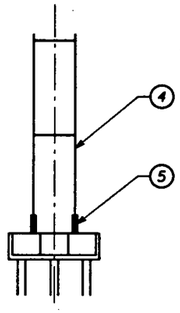


(5) ERECT PILOT LINE, HAULING LINE, AND CATWALK
(6) ERECT & COMPACT CABLES, AND INSTALL CABLE CLAMPS AND HANGER STRANDS

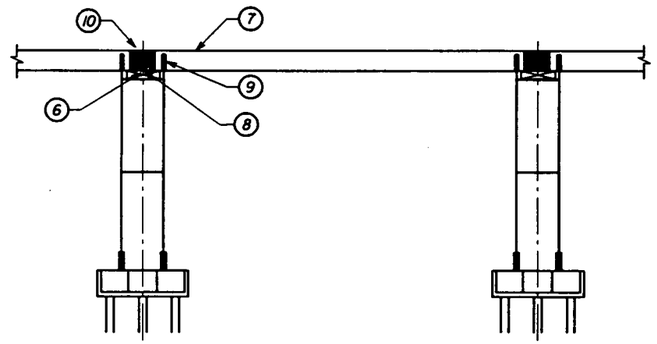
MAIN BRIDGE CONSTRUCTION SEQUENCE



(1) FLOAT IN PRECAST CONCRETE CAP
(2) DRIVE STEEL PIPE PILE THROUGH PRECAST CONCRETE CAP
(3) CONNECT STEEL PIPE PILE TO PRECAST CONCRETE CAP USING TREMIE SEAL, REBAR CAGES AND SUPER PLASTISIZED CONCRETE



(4) ERECT PRECAST CONCRETE PIERS USING HEAVY LIFTING EQUIPMENT
(5) CONNECT PIERS TO CAP WITH CAST-IN-PLACE CLOSURE POUR



(6) INSTALL TEMPORARY SUPPORTS ON HYDRAULIC JACKS ACROSS THE PIERS
(7) ERECT SUPERSTRUCTURE GIRDERS USING HEAVY LIFTING EQUIPMENT
(8) LEVEL THE GIRDER USING THE TEMPORARY SUPPORT JACKS
(9) CONNECT THE GIRDERS TO THE PIERS THROUGH CLOSURE POURS
(10) CONNECT THE GIRDERS ACROSS THE PIERS THROUGH HORIZONTAL CLOSURE POURS

VIADUCT BRIDGE CONSTRUCTION SEQUENCE

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Item 7

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